Precision Temperature Control System for Packaging Machine Heating Jack

Abstract:

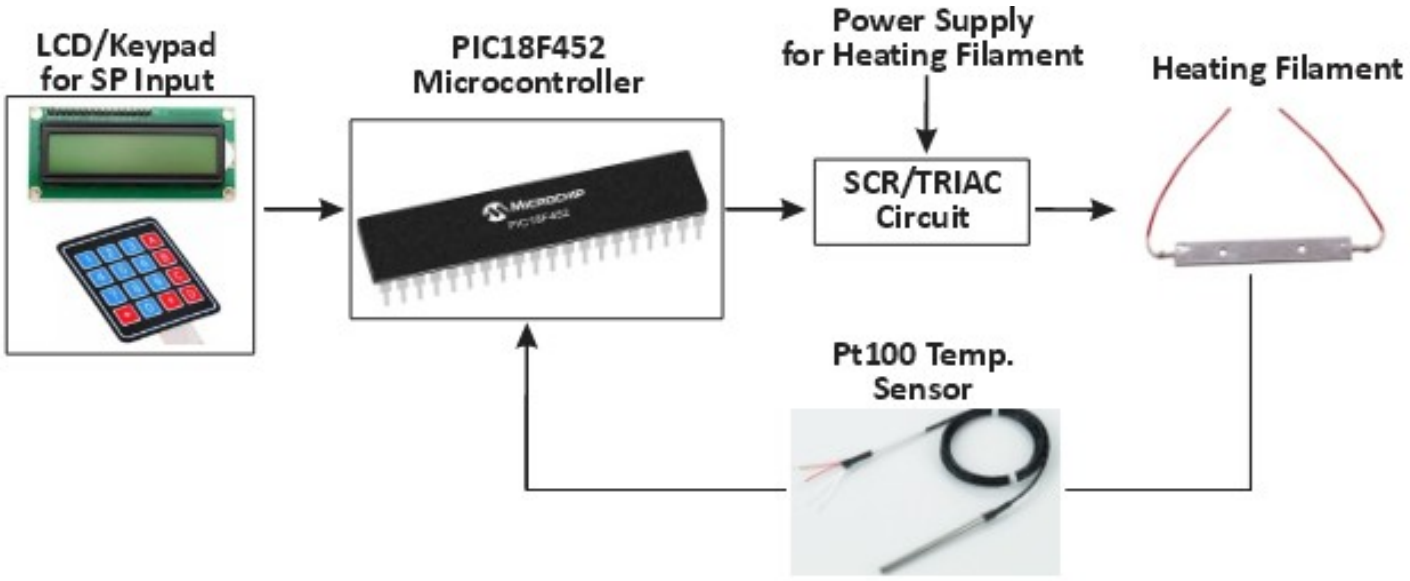
This project focuses on the development of a **microcontroller-based closed-loop temperature control system** for heating applications in **automated packaging machines**. At the core of the system is the **PIC18F52 microcontroller**, which regulates the temperature of a **nichrome heating filament** used in the **heating jack** of the packaging equipment.

The **nichrome filament**, known for its high resistivity and heat tolerance, is powered via a **heat controller circuit** that is precisely actuated by the microcontroller through **PWM or digital control signals**. To monitor and regulate temperature in real time, a **PT100 RTD sensor** is interfaced to the PIC18F452 via a suitable **analog signal conditioning circuit** and ADC input.

The microcontroller continuously reads the temperature from the PT100 sensor, compares it against a **user-defined Set Point (SP)**, and adjusts the power delivered to the heating element to maintain the desired temperature. This forms a **closed-loop PID-like control** system, ensuring the filament remains within ±1–2°C of the SP.

Such a system is ideal for industrial applications where **thermal precision and repeatability** are critical, such as sealing operations in **packaging lines**. By using a PIC microcontroller, this project provides a **cost-effective alternative** to traditional thermostatic or PLC-based controllers, while retaining flexibility, accuracy, and ease of integration.

Block Diagram:



Key Features:

- Real-time temperature monitoring using PT100 sensor
- Precision control of nichrome heating filament via heat controller
- Set Point (SP) temperature input via buttons or serial interface
- PID-like feedback control implemented in firmware
- Compact and reliable embedded solution using PIC18F452

Advantages:

- **High-precision thermal control** ideal for packaging machine jacks
- **Low-cost alternative** to commercial PID/PLC controllers
- **Programmable logic** allows easy tuning of temperature profile
- **Compact system** suitable for embedded integration
- **Easy to maintain and scale** in production environments

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